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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/817,056	03/27/2001	Kai Yang	50432-067	9188

7590 02/13/2004

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EXAMINER

NGUYEN, THANH T

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 02/13/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

AK

Office Action Summary	Application No.	Applicant(s)	
	09/817,056	YANG ET AL.	
	Examiner	Art Unit	
	Thanh T. Nguyen	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 November 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) 13-20 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 6-12 is/are allowed.
- 6) ☒ Claim(s) 1-5 and 21-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>10/1/03</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims 1-5, 21 have been considered but are moot in view of the new ground(s) of rejection.

Information Disclosure Statement

The information disclosure statement filed on 10/1/03 has been considered.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-2, 5, 21 are rejected under 35 U.S.C. 102(e) as being anticipated by Morand et al. (U.S. Patent No. 6,521,533).

Referring to figures 1, 3-4, Morand et al. teaches a method of manufacturing a semiconductor device, the method comprising:

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Forming a single first dielectric layer (4) over a substrate;

Forming a first barrier layer (5, called hard masking layer), comprising a first dielectric barrier material (silicon carbide, see col. 3, lines 3-5), on the single first dielectric layer with an interface therebetween,

Etching to form a single opening (6, called via hole) defined entirely by side surfaces of the single first dielectric layer (4) and a bottom of the first dielectric layer (4);

Forming a second barrier layer (7, called protective layer), comprising a second dielectric barrier material (silicon nitride (SiN), see col. 3, lines 38-43) different from the first dielectric barrier material, on an upper surface of the first barrier layer overlying the single first dielectric layer, on the side surfaces of the single dielectric layer defining the single opening and on the bottom of the single opening (see figure 3);

Etching (see figure 4, col. 3, lines 44-60), with selectivity to the first barrier layer, to remove the second barrier layer from, and stopping on, the upper surface of the first barrier layer, and to removing the second barrier layer from the bottom of the single opening, leaving a portion of the second barrier layer as a liner on the side surface of the single first dielectric layer defining the single opening; and

Filling the single opening with metal (copper, see col. 3, line 48, and claim 1) to form a lower metal feature.

Regarding to claim 2, see col. 3, lines 3-8).

Regarding to claim 5, (see col. 3, line 48, and claim 1).

Regarding to claim 21, (see figure 1).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3-4, 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morand et al. (U.S. Patent No. 6,521,533) as applied to claims 1-2, 5, 21 above, Chooi et al. (U.S. Patent No. 6,284,657) and Wolf "Silicon Processing for the VLSI Era" vol. 1, pages 193-195.

Inohara et al. teaches all of the limitations as described in claimed invention above. However, Inohara et al. does not teach forming a first and second dielectric barrier materials from the group consisting of silicon nitride, silicon oxynitride and silicon carbide by CVD process with thickness of about 50-500 Å.

Chooi et al. depositing first barrier layer of silicon nitride (20, SiN) at a thickness of between 500-5,000 Å (see col. 5, lines 43-45) and second barrier layer (15) at the thickness of between 50-5,000 Å (see col. 6, lines 23-33) by chemical vapor deposition (CVD, see col. 6, lines 23-33, meeting portion of claim 3).

Regarding to claim 22-23, see figures 12-13, col. 5, lines 45-47.

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would form first barrier layer of silicon nitride at a thickness of between 500-5,000 Å and second barrier layer of silicon carbide at the thickness of between

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50-5,000 Å by chemical vapor deposition in process of Morand et al. as taught by Chooi et al. because the process would be known in the art to prevent the copper diffusion.

Wolf teaches forming a silicon nitride layer by using CVD process (see Pages 193-195).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time the invention was made would depositing a silicon nitride layer by a CVD method in Morand et al.'s process as taught by Wolf. *because* depositing a silicon nitride layer by CVD process would provide a film layer having good thickness uniformity, high purity and good step coverage.

The thickness of the claim 4 are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted In re Aller 105 USPQ233, the selection of reaction parameters such as temperature and concentration would have been obvious:

“Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed “critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.”

In re Aller 105 USPQ233, 255 (CCPA 1955). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmscher* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

Therefore, one of ordinary skill in the requisite art at the time the invention was made

would have used any thickness range suitable to the method in process of Morand et al. in order to optimize the process.

Allowable Subject Matter

Claims 6-12 are allowed over the prior art.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:00AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, can be reached on (571) 272-1702.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (See **MPEP 203.08**).



Thanh Nguyen
Patent Examiner
Patent Examining Group 2800

TTN